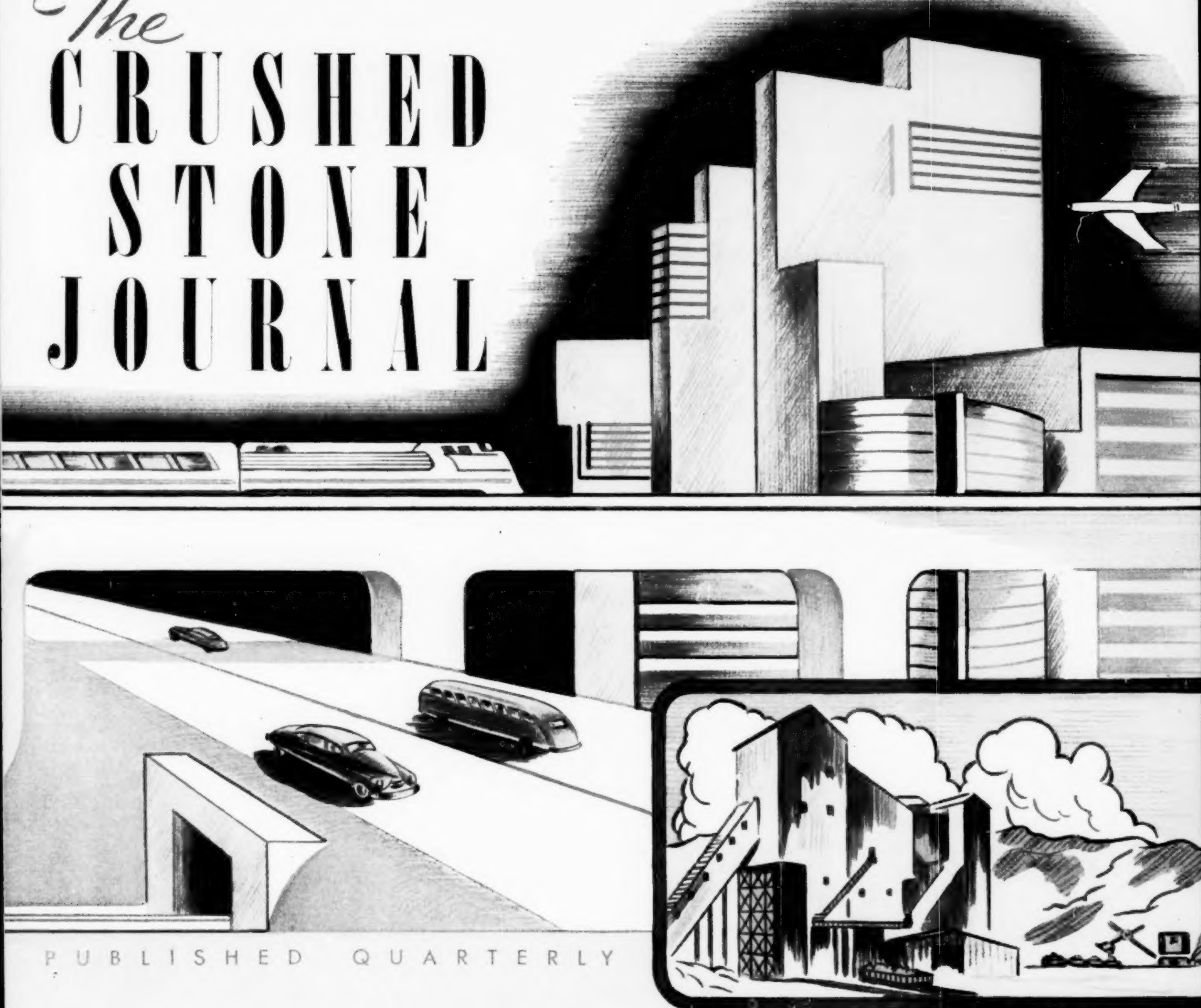
The CRUSHED STONE JOURNAL



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In This Issue

OFFICIAL PUBLICATION · NATIONAL CRUSHED STONE ASSOCIATION

Technical Publications
of the
National Crushed Stone Association

STONE BRIEFS

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No. 2. How to Proportion Concrete for Pavements

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No. 11. A Method of Proportioning Concrete for Strength, Workability, and Durability. **(Revised November 1953)**

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Single copies of the above publications are available upon request.

The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

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41st NCSA

Annual Convention

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FEBRUARY 17, 18, 19, 1958

THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

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Public Relations—The Engineering of Consent[1]

By MAJ. GEN. LOUIS W. PRENTISS (USA, Ret.)

Executive Vice President
American Road Builders Association
Washington, D. C.

NO matter how quickly the road builders of America are on the line for action, the program will not get going in high gear until a pre-selling job is done to overcome local skepticism or outright opposition. The public relations job that lies ahead is the key to public acceptance and approval.

The controlled or planned access highway is a new concept to a large part of our population, particularly in the rural areas. Although everybody enjoys the many benefits of this type highway after it is built, there will be many squabbles as to where it shall be located, whose land it will take, how wide the right of way need be, and where the entrances and exits will be spotted. We have come to believe that it is our inalienable right as a land owner to have access "from my land" to any road adjoining it built with public funds, and particularly so if part of "my land" is "taken" for the right of way. (No matter how good a price is paid by the highway department for the land when purchased the owner always refers to it as "taken.")

The Objectives of Public Relations:

To gain recognition, build prestige, develop understanding and gain approval by making deeds known, motives understood, and one's information believed.

—EDWARD BERNAYS.

Recently we have seen old highways straightened and widened to accommodate ever-increasing traffic. Numerous traffic control routes, bluntly called by-passes, have been built to permit heavy through-traffic to avoid business centers. And then what happened? In a matter of months new businesses, roadhouses and supermarkets sprung up all along the new routes. This unplanned growth generated traffic and parking that reduced capacity of the roads to such an extent that they could not carry the traffic for which they were built. To the highway engineer, trying to make his funds stretch all over the state, this accelerated obsolescence is a discouraging factor in a losing battle against traffic strangulation.

The Illness

The new concept of limited access will prevent this accelerated obsolescence of our new interstate highways. Traffic requirements are projected to 1975. We shall acquire the necessary rights of way and build a six or eight lane controlled access, divided highway. Nothing can reduce the highway's carrying capacity except poor maintenance and poor weather. Sounds easy if this is the case. The one thing missing is an all-important element in building a highway . . . public relations to overcome a lack of public education. Even people in high positions, the leaders of our communities, don't know the great benefits inherent in a limited access highway serving their community. When the leaders don't know, we certainly can't expect the rank and file to know.

The Remedy

We have only a limited number of controlled access roads in operation, and most of them are toll roads and have been completed only a relatively short time. But we have been able to observe the dynamic and dramatic economic impact in practically every area served by them. There is no doubt: limited access

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1 Reprinted from *American Road Builder*, March 1957

traffic control routes around towns have invariably rejuvenated the by-passed town, cured its disease of traffic paralysis, opened the streets to people who want to be *in* the town, not passing through the town, and have brought the merchants greater prosperity by facilitating shopping in the local stores. This is a story that needs to be told with facts and figures in every community where there is opposition to the state engineer's plan to locate or relocate the interstate system. And it should be told *before* the public hearing.

With a superhighway system, interconnecting 90 per cent of all of our cities with populations of 50,000 or greater, designed and built for safe speeds of 50, 60, or 70 miles an hour depending upon terrain, with no stop signs or traffic lights, and with the same characteristics whether in a city or in the country, we are approaching a type of nation-wide automobile travel which is revolutionary.

History — Not Theory

This type of highway converts miles into minutes. Areas adjacent to our cities and towns which previously were undeveloped because of inaccessibility suddenly become minutes from town. Sites between the highway and the railroad track suddenly become valuable industrial sites because overnight they are only minutes from labor and materials. Real estate values skyrocket and in a matter of months increase 10 fold. New attractive residential areas spring up on what was low value farm or woodland, and wherever we find these new residential or industrial areas we also find a new and expanding commercial development to support them.

Industry is expanding and decentralizing. Areas with the most to offer will benefit from industrial decentralization. Developments during the past three or four years confirm the fact that the limited access highway, which makes abundant parking areas and cheap land available only minutes from town, is a major inducement in attracting industry to a community.

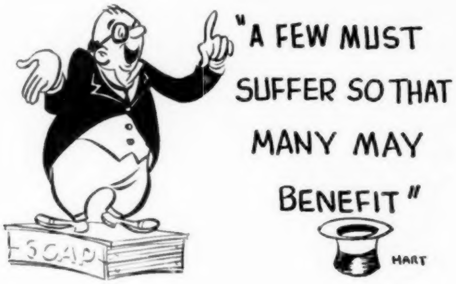
Limited Access Use Unlimited

The interstate system should be a high-speed automobile right of way similar to a transcontinental railroad. We will enter it and leave it only at a station. The all-important primary, secondary, and urban roads serving the area must attach themselves to the interstate like ribs on a backbone. The limited access characteristic will not necessarily be limited to the interstate system. In many places the states will find it advisable to build this characteristic into some primary systems.

Although the Highway Act of 1956 provides for all classes of federal-aid highways in increased amounts, the criteria for the Interstate National Defense System are new. Of the 41,000 miles of interstate mileage about 55 per cent dollar-wise is urban construction. This mileage not only must be built to newly adopted standards but it must also be planned to carry the traffic which is projected 18 years from now, or to 1975.

More Than Road Plans

In the major cities where there are planning commissions, or at least a planning engineer, there may be in existence at this time a sound plan for city growth including the kind and sizes of new industries which the city hopes to attract. New industrial, commercial and residential areas may be blocked out. Their location, size and characteristics will have material effect on the highway planners' projected traffic study.



But what about the small towns whose only planning body may be the committee of the local chamber of commerce? The highway planner will be the man who makes many important decisions for these towns and counties. The characteristics of the interstate system will enhance the future growth of the area through which it runs. A public relations job will have to parallel this responsibility.

The many potential benefits and dangers of costly delays must be brought home to the people on Main Street. The theme which must be preached throughout America, with reference to location of the limited access interstate system, is "the few must suffer or be inconvenienced, if necessary, so that the many may benefit."

Public Hearings

The Highway Act authorizing the interstate system provides that each state will hold public hearings wherever the route by-passes or goes through a community. Naturally this is done in order that the interests of the local people can be taken into consideration prior to making final decision on a location. The truth is, however, that the local people are not entirely aware of their best interests. They do not know for sure just what the new highway

will mean to them. That is why those who oppose a proposal usually appear in larger numbers and talk longer and louder than do those who favor the project.

And that is precisely why a softening-up, or preselling, public relations campaign must be waged in those communities *before the public hearing is held.* The citizenry must know that their gains will offset many-fold the small losses of a few dissenters who for personal reasons resist the proposal. Opportunities to accomplish this pre-selling job should not be overlooked by state highway departments, chambers of commerce or other civic groups interested in area progress.

We Must Move

When the Highway Act of 1956 was passed, it was widely hailed as a "Pay-As-You-Go" program. It provided for increased taxes to be added to the existing taxes on highway users. It also provided for establishment of a Highway Trust Fund in the Federal Treasury into which the receipts from the old and new taxes alike would go. A forecast of this revenue indicated that during the next 16 years about $38.5 billion will funnel into the Trust Fund to be used only for financing the federal participation in the accelerated highway program. We do not want this to become a "Pay-As-You-Don't-Go" program.

It is my belief that the taxpayers are perfectly willing to pay the added taxes, because they generally realize that the resulting highway system will pay generous dividends year after year in added safety, elimination of delay, reduction in wear and tear on equipment, and numerous other direct and indirect economic benefits. But if the program drags, and the roads don't get built so that some of the dividends can roll in, the taxpayers will become restless. Such restlessness will likely result in organ-

(Continued on Page 10)

A Rapid Method for Determining the Durability of Ledge Rock[1]

By JOSEPH E. GRAY
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National Crushed Stone Association
Washington, D. C.

THERE is being developed in the laboratory of the National Crushed Stone Association a method of testing ledge rock for evaluating its potential performance with respect to its durability as an aggregate in portland cement concrete.

At the present time the American Society for Testing Materials and the American Association of State Highway Officials, both have a test procedure for determining the soundness of aggregate by the use of sodium or magnesium sulfate. This test consists of determining the loss in weight of the commercially produced aggregate, after being subjected to 5 cycles of immersing and drying, using either of the salt solutions. It is believed that the sulfate soundness test is of value in appraising the durability of sedimentary or metamorphic rocks whose lack of durability is due primarily to the inclusion of shale or clay minerals. However, there is a form of unsoundness which this sulfate soundness test does not detect; therefore, a degree of dissatisfaction exists among testing engineers with respect to this test.

One attempt to overcome this dissatisfaction has been to use the same test procedure, that is, a weight loss on the crushed and sized aggregate, but to subject the aggregate, after soaking in water, to a freezing and thawing test. This test is believed to be of questionable value because distress occurs in concrete without any disintegration of the coarse aggregate.

About 25 years ago, investigations were made for evaluating the performance of aggregate by making concrete specimens which, after curing, were subjected to freezing and thawing in water. The rate of deterioration was determined by measuring the change in length of the specimen after regular increments of the freezing and thawing cycle. Of course, this work was done before air entrainment was known or the sonic modulus apparatus had been developed. The fact was that the measurement of change in length, which always was a permanent increase in length, was a dependable means of evaluating the durability of the concrete. When the use of air entrainment came into general practice, durable mortars were produced so most unsoundness that has occurred in concrete since then has been attributed to the behavior of the coarse aggregate. Therefore, considerable testing, of coarse aggregate for durability, has consisted of fabricating concrete specimens and, after curing, subjecting the concrete to a freezing and thawing test. The test procedures are not standardized (four ASTM Tentative Standards are in existence) and require several months to obtain results. Yet, if distress manifests itself by an increase in length and this increase is due to the behavior of the coarse aggregate, a logical deduction would be to test the coarse aggregate alone for increase in length.

In order to make a rational approach toward the development of such a test, a recognition of certain facts and phenomena that have been brought to light by other investigators must be stated:

Rhoades and Mielenz state: "These characteristics of the internal pore structure will control freezing-and-thawing durability through their effect on saturation ratio and the facility with which water can escape from the freezing zone. Pores less than 4 microns (0.004 mm) in diameter control the durability of solid materials subjected to progressive freezing. In a broad sense, the internal pore characteristics of the particles are the most important properties of aggregate materials."

Powers says: "It seems fairly certain that forces produced by freezing in rock are predominantly hydraulic." In other words, when a saturated rock is subjected to freezing, the ice crystals which form and expand create hydraulic pressure in the unfrozen water due to its inability to flow in fine capillaries, and this hydraulic pressure causes a change in volume or dilation. Dilation is the term used by Powers to indicate volume change produced

[1] Presented at the Meeting of American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New Orleans, Louisiana, February 27, 1957

by freezing water. It is a permanent increase in volume as contrasted to expansion and contraction due to temperature changes.

There are a number of factors which affect the dilation of a rock such as the porosity, the degree of saturation, the presence of microscopic voids, the size of the specimen, and the strength and rate of freezing. Rocks with a relatively high absorption may have pores of a size that water can move away as ice forms so that hydraulic pressure is not created, thus causing no dilation or unsoundness. A corollary to this statement is that the amount of absorption is no indication of soundness unless it is very small or approaches zero, thereby assuring high durability. Water expands 9 per cent upon freezing; so, if the small capillary pores are 91.7 per cent filled with water they will be completely filled upon freezing; but, since no excess water is present, hydraulic pressure will not be produced. This condition is, theoretically, the critical degree of saturation. Probably the distribution of pore space in rock is not absolutely uniform, so it may be that the critical degree of saturation is from about 80 to slightly over 90 per cent. Some rock may contain microscopic voids which do not become filled under capillary saturation so may act as reservoirs for the relief of hydraulic pressure or strain, thus, there is no dilation. Size of specimen would obviously affect the development of hydraulic pressure, and Thomas found that increasing the size of specimen increased the deleterious effects of freezing. It, therefore, is indicated that a specimen approaching the nominal maximum size of aggregate would be a desirable size for subjecting to a freezing test.

New Method of Test

By giving consideration to the foregoing studies on the mechanism of freezing and thawing, to past experience in testing for soundness, and to the availability of laboratory apparatus, a method of test for durability of ledge rock has been developed which is believed to have merit. A description of the test procedure follows:

Scope

This method of test is intended to provide information on the volume change of ledge rock as caused by freezing and thawing in a wet condition. Volume change or dilation as measured is the increase in a linear dimension of the test specimen.

Apparatus

A description of all of the laboratory equipment used to make this test is too involved and lengthy for this paper; therefore, a listing of the equipment will be given with the necessary description of the comparator, which is, essentially, the new feature in making this test.

1. The usual diamond core drill, diamond saw, and grinding lap for the preparation of the specimen
2. Suitable container with vacuum pump to vacuum saturate the specimens
3. Automatic freezing and thawing machine which provides for about ten cycles per day
4. Balances in order to make determinations of specific gravity and absorption, for calculating the degree of saturation
5. A comparator with special supports for the specimen to measure changes in length (Figure 1)

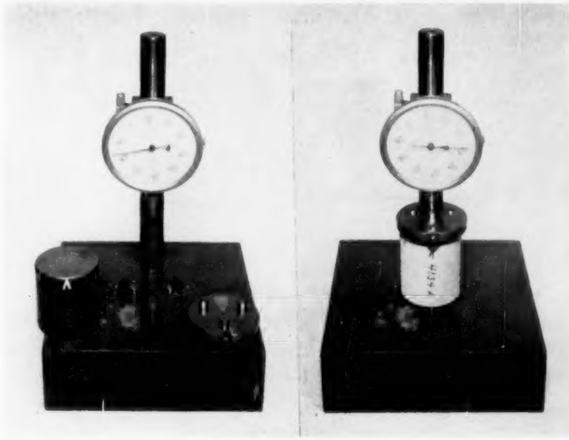

FIGURE 1
Core Length Comparator

The comparator consists of an Ames dial attached to a column support which is fastened to a base plate. The Ames dial has a range or travel of 0.1 in. and can measure length changes in increments of 1/10,000 of an inch. Three short posts with slightly rounded tops are mounted on the base plate concentric with the axis of the dial plunger for supporting the specimen. Two small angles are mounted radially to the two rear bearing points to act as a guide for positioning the specimen. A steel cap which has three posts on one side, similar to those in the base, and a collar

centered on the other side to receive the dial plunger is placed on top of the specimen. To insure that readings are not affected by disturbances of the dial mounting, a 2 by 1 3/4 in. diameter mild steel reference standard is provided. (Figure 2)

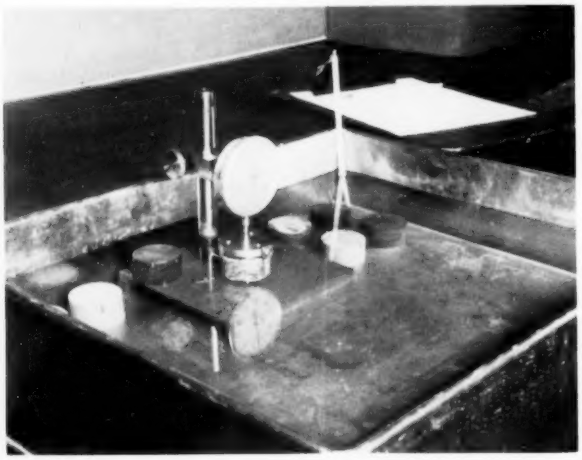

FIGURE 2
Comparator and Specimens in Temperature Controlled Water Bath for Taking Readings of Length

Preparation of Specimen

Cores, 1 3/4 in. in diameter, are drilled from ledge rock samples, and are cut with a diamond saw into 2 in. lengths. The ends are ground plane on a lap and glass plate with fine carborundum grit (No. 80 or finer) and the edges are rounded slightly to prevent chipping in handling. These ends should be plane, parallel to one another, and perpendicular to the longitudinal axis. Since the dial has a travel of only 0.1 in., great care must be exercised in the preparation of the specimen in order to have proper seating and dial range.

Introduction of water to specimen

This is the most controversial phase of the test. Should the specimen be vacuum saturated, immersed in water for 24 hours, or immersed in water for some longer period? Should the specimen be saturated to a degree that it will have in service; if so, what is that degree? Our thinking at the present time is that if the stone is to be used in concrete that will be subjected to prolonged hydraulic pressure, the specimen should be vacuum saturated. If the concrete is to be subjected to alternate wetting and drying as pavement concrete, the specimen should be immersed in water for 24 hours. However, if the stone is highly saturated when quarried, and used almost immediately so that drying is negligible, probably a vacuum saturated specimen should be used. Air-dry weights of the specimens are obtained as well as saturated surface-dry weights, and oven dry weights made after completion of the test in order to calculate the degree of saturation.

Test procedure

The identification number is marked on the prepared cores with India ink and three equi-distant marks are made on the top face for taking length measurements in three positions which are averaged for the recorded data. A measurement of length is made on the dry specimen for the purpose of detecting any expansion due to soaking. The initial measurement or the base reading is made after saturating and subsequent readings are made at regular increments of freezing and thawing. (Figure 2) All length measurements are made in a temperature controlled water bath. The specimens are wrapped with aluminum foil during freezing and thawing for the purpose of retarding evaporation of moisture. (Figure 3) Ten cycles per day are obtained with the

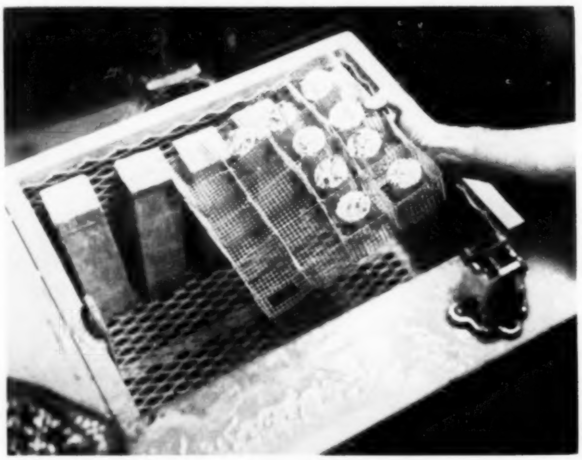

FIGURE 3
Foil Wrapped Specimens Being Placed in Automatic Freezer

automatic cycling freezer which freezes the specimens in air and thaws them in water. At the present time a rate of dilation greater than 20 x 10^{-6} in. per in. per cycle or 0.1 per cent in 50 cycles is considered excessive. In other words, test results can be obtained in a 50 cycle test which will require about one week.

The results of a large number of tests of rock from many ledges in various quarries are given in Table I, from which a comparison can be made of the effect of testing vacuum saturated specimens and the 24-hour immersed specimens, with the sodium sulfate soundness test. A study of the data reveals the lack

(Continued on Page 14)

TABLE I

RESULTS OF FREEZING AND THAWING TESTS[1] ON 1 3/4 IN. DIA. BY 2 IN. LEDGE ROCK CORES IN ORDER OF INCREASING RATE OF DILATION OF VACUUM SATURATED CORES

		Vacuum-Saturated Cores			24 hr—Immersed Cores			
Order No.	Lab. No.	Dilation[2] in./in./cycle x 10^{-6}	Absorption per cent by wt	Saturation per cent of voids	Dilation[2] in./in./cycle x 10^{-6}	Absorption per cent by wt	Saturation per cent of voids	Sulfate[3] Soundness Loss per cent
1	4063	0.9	4.60	83.9	2.1	1.78	39.7	0.5
2	4148	1.4	0.13	70.9	0.0	0.12	80.1	0.3
3	4132	2.4	2.69	74.9	1.3	1.53	43.0	1.4
4	4048	3.0	0.25	38.3	5.4	0.17	28.6	0.5
5	4134	3.4	7.07	100.0	2.8	4.41	63.8	4.1
6	4068	4.2	0.36	40.2	3.4	0.21	20.3	0.7
7	4064	4.5	3.29	82.9	7.8	1.83	49.6	12.6
8	4061	4.5	3.49	83.0	5.3	1.53	38.2	1.6
9	4133	4.6	8.40	94.2	2.5	5.61	61.2	5.6
10	4082	9.6	0.02	11.6	2.4	0.02	1.0	0.2
11	4046	9.6	0.73	100.0	3.1	0.50	62.8	0.2
12	4099	10.7	3.71	87.8	18.3	2.84	70.4	6.2
13	4107	11.4	0.47	25.8	53.5	1.94	89.0	3.6
14	4069	11.4	1.48	81.6	9.4	2.54	68.2	1.5
15	4130	11.8	0.95	61.4	23.9	0.93	72.4	13.2
16	4071	12.0	0.60	79.4	9.4	0.97	53.8	1.1
17	4070	13.1	0.40	45.4	25.8	0.40	40.4	3.1
18	4097	16.9	3.82	87.7	21.7	1.94	52.6	8.8
19	4062	17.7	5.26	89.6	19.5	2.31	42.6	4.0
20	4077	23.6	0.85	70.1	2.0	0.40	33.5	1.9
21	4098	31.9	5.21	91.2	176.5	4.10	76.3	18.1
22	4047	35.0	5.15	100.0	0.8	2.06	43.6	0.2
23	4096	35.5	3.70	89.6	224.0	3.15	78.1	10.8
24	4080	40.2	3.08	100.0	1.1	1.53	50.7	2.6
25	4095	41.2	1.35	100.0	121.7	1.25	100.0	57.6
26	4079	47.5	4.05	100.0	51.8	2.89	74.1	8.9
27	4073	56.2	2.00	96.1	1.9	0.75	46.5	0.3
28	4078	57.0	2.93	100.0	1.4	1.47	52.7	1.8
29	4100	70.9	6.52	93.3	188.0	5.63	77.9	27.2
30	4072	73.3	6.77	95.1	9.4	9.97	80.2	15.7
31	4052	99.0	3.25	94.7	8.7	2.38	71.1	6.4
32	4081	107.3	3.94	100.0	2.2	2.42	65.3	3.7
33	4076	123.3	2.62	97.5	0.3	1.36	50.9	1.5
34	4049	171.7	3.41	99.8	17.9	2.49	63.9	3.6
35	4050	198.3	2.76	99.6	1.1	1.34	48.2	0.4
36	4051	230.0	3.52	100.0	4.7	2.31	62.1	1.7
37	4074	1021.0	6.01	100.0	1.2	2.46	61.9	4.7
38	4075	1246.7	5.08	100.0	0.8	2.25	52.7	2.8

1 Freezing and thawing exposure continued for at least 50 cycles for cores not failing

2 Rate of dilation greater than 20 x 10^{-6} in. per in. per cycle (0.1 per cent in 50 cycles) considered to be excessive

3 Ledge rock method, 5 cycles in sodium sulfate

Bill N. Southworth Joins NCSA Staff As Assistant to the Executive Director

Bill N. Southworth
Assistant to the Executive Director

THE National Crushed Stone Association announces the appointment of Bill N. Southworth as Assistant to the Executive Director to fill the vacancy created by the resignation of R. M. Prewitt. Mr. Southworth assumed his new duties on August 1, 1957, and comes to the organization with a broad experience in association work. A native of Seattle, Washington, he was educated in the public schools of Seattle and Los Angeles, and graduated from the University of Southern California. Mr. Southworth entered association work following World War II where he served in the European Theatre with the U. S. Army Corps of Engineers from Normandy to Germany. Except for a brief return to active duty during the Korean Emergency, Mr. Southworth has been working with various aspects of association activities such as public relations, news writing, conventions, organization, and committee work. Mr. Southworth, with his wife and two daughters, has established a home in Silver Spring, Maryland, after a move from San Francisco, California, to accept the position as Assistant to the Executive Director, J. R. Boyd.

Public Relations — The Engineering of Consent

(Continued from Page 5)

ized efforts to get certain taxes reduced or eliminated. Unspent or unobligated balances in the Highway Trust Fund will be looked upon with covetous eyes by other interests seeking support for health, welfare, education, or security programs. We must remember always that "what Congress gives, Congress can take away!" The highway industry is committed to the accomplishment of the 13-year program and must be alert to discover and help to eliminate all obstacles which might prevent that accomplishment. The public must be told this, along with the enumeration of benefits.

Who is going to do this big job of public education? Who is going to keep the program sold and underscore the resulting benefits? It is a nationwide job and one that must be carried on simultaneously in every corner of the country.

Where to Begin

The job must be done within every city and town affected by the contemplated highway program, and it can be done only by the civic leaders in those towns. We must put into the hands of these civic leaders the facts concerning their immediate problems and then spark them into action. It is a job that needs the dedicated support of the local press, the enthusiastic participation by the Chamber of Commerce, the valuable addition of acceptance by women's groups, backed up by the active businessman leadership found in the civic luncheon clubs. Any area that lets selfish interests or petty politics prevent the making of highway locations is strangling itself. The town that gets there "fustest with the mostest" in the building of a limited access highway is the one that stands the best chance of reaping quickly the harvest of potential benefits.

The highway location engineer takes all factors into consideration before recommending a route. He knows what the land is worth, what improvements are there, what the comparative construction costs will be, what the potential growth of the area will be, what the traffic demands will be and who the objectors will be. He also knows that if he shifts the location to satisfy these objectors he will succeed only in shifting the same objections to a different group of objectors. He will hear the same record played but by a different disk jockey.

Nearly every location is going to hurt someone. As the wheels of progress slow under the load of pressure we must grease them with plain facts. Indeed, the engineering of consent is the primary engineering job to be done.

Appraisal of the First Year Multi-Billion Dollar Highway Program

Prepared by Transportation and Communication Department
Chamber of Commerce of the United States
Washington, D. C.

The First Year Milestone

The first year milestone of the multi-billion dollar federal-aid highway program has just passed. Has the program progressed as it should, and what are the barriers to future progress?

Conflicting Reports

The public has heard conflicting views that have been expressed in regard to progress made on the road program.

Generally, we find the amateurs on one side of the issue maintaining a pessimistic view, whereas the experts on the other side see the program moving along on schedule. This appraisal is intended to give you a better understanding of the facts in the case.

Measurements of Progress

There are a number of ways to measure what progress has been made so far. The factors in each of these ways must be understood or there is considerable danger of misinterpretation. For instance, the number of miles of road built, under construction or even under contract is sometimes used as a measure of progress. It is a poor measure, however, at this early date in view of the months of preparation necessary in determining route locations, drafting plans, buying rights-of-way, and letting contracts. A large percentage of the funds already obligated have been for right-of-way acquisition and preliminary engineering, both of which provide little visible evidence of progress.

Disbursements from the Highway Trust Fund, which sometimes is also used, is a poor measure of the first year progress. Funds obligated the first year may not actually be withdrawn for 18 to 24 months or longer after the plans have been approved by the Bureau of Public Roads due to the time factors described above. Funds are withdrawn only as work progresses. Final payments are withheld until all work is done and approved. The Bureau estimated at the outset that during the fiscal year of 1957 slightly less than one billion dollars would be spent from the Trust Fund. The actual amount has been $970 million. This expenditure has been in a large measure for commitments made prior to the fiscal year of 1957.

The best way to measure progress at this time is to review the funds that have been obligated by the federal government and the states in the light of amounts available and in comparison with previous years. The term "obligated" applies to funds that have been allotted to approved federal-aid projects. The projects may or may not be under contract or construction. Only federal-aid projects are included because of lack of reliable information on non-federal-aid projects.

There are two sets of figures currently available that will measure progress of the federal-aid highway program: 1. obligations for all federal-aid highways which include interstate, primary, secondary, and urban funds, and 2. obligations for the interstate highway system only. The last category seems to be the one in which most people are interested. It should be kept in mind, however, that the federal-aid program will provide only about one-half of the funds for the $100 billion street and highway modernization job, and that the interstate system costs only a little more than one-fourth of the total.

A Look at the Facts

The states had a total of $4,430 million federal-aid funds to obligate during the fiscal year of 1957 (the fiscal year runs from July 1, 1956 through June 30, 1957). This amount includes funds for both fiscal years 1957 and 1958 made available by Secretary of Commerce Weeks out of amounts authorized by the Congress in the Federal-Aid Highway Act of 1956 and funds still available from previous apportionments; of this amount $1,584 million was for the primary, secondary, and urban roads, and $2,846 million for the interstate system.

During the year the states obligated $827 million federal-aid funds out of the $1,584 million available for the primary, secondary, and urban roads, or 52

per cent. The funds require matching in equal amounts by state funds. Of the $2,846 million available for the interstate system, $1,386 million was obligated, or 49 per cent. The state must match this amount on a 90-10 basis.

It should be pointed out that at the time Secretary Weeks apportioned both the 1957 and 1958 funds to the states it was not with the intent or expectation that all of these funds would be obligated the first year of the highway program. The purpose for making funds available for several years in advance is to give the states and highway construction industry a chance to plan ahead.

Comparing the progress of fiscal 1956 and 1957, the states obligated only 12 per cent more work in 1957 on the federal-aid roads not on the interstate system. But on the interstate system the states obligated *nine* times as much work.

Progress by States Varies

So far we have concerned ourselves with the national picture which looks good. Unfortunately progress has not been uniform in all states.

According to the Bureau of Public Roads, 30 states have now obligated all of their fiscal 1957 apportionments and part of their 1958 primary, secondary, and urban funds. Iowa, California, and Wyoming are the leaders in percentage of 1958 funds obligated. Nine

TABLE I

PROGRESS OF THE INTERSTATE SYSTEM PROGRAM
DEPARTMENT OF COMMERCE, BUREAU OF PUBLIC ROADS
RELATIONSHIP TO FISCAL YEAR AUTHORIZATIONS, AS OF JUNE 30, 1957

Percentage of 1958 funds covered by contracts advertised and funds obligated		Percentage of 1957 funds covered by contracts advertised and funds obligated								
		100 per cent	75–100 per cent		50–75 per cent		25–50 per cent		0–25 per cent	
State	Per cent	State	State	Per cent	State	Per cent	State	Per cent	State	Per cent
Calif.	98	Calif.	Iowa	85	N. H.	74	Ark.	48	Maine	18
R. I.	96	R. I.	Ky.	85	N. C.	74	Nev.	48	W. Va.	0[1]
Md.	95	Md.	Fla.	80	Mont.	70	S. C.	44		
N. Mex.	66	N. Mex.	Ala.	76	N. Dak.	68	Del.	37		
Wyo.	58	Wyo.	Kans.	76	Tenn.	68	Ind.	37		
Ill.	57	Ill.			Ga.	60	Va.	28		
N. Y.	55	N. Y.			La.	59	Nebr.	27		
Ohio	54	Ohio			S. Dak.	58				
Mo.	47	Mo.			Wis.	58				
Minn.	43	Minn.			Idaho	51				
D. C.	32	D. C.			Utah	50				
Pa.	30	Pa.								
Colo.	24	Colo.								
Miss.	24	Miss.								
Mich.	22	Mich.								
N. J.	22	N. J.								
Texas	20	Texas								
Oreg.	17	Oreg.								
Conn.	15	Conn.								
U.S. Average	14	U.S. Average								
Ariz.	8	Ariz.								
Vt.	7	Vt.								
Mass.	5	Mass.								
Wash.	2	Wash.								
Okla.	1	Okla.								
24 States		24 States	5 States		11 States		7 States		2 States	

[1] West Virginia has obligated $1,318,254 since passage of the Federal-Aid Highway Act of 1956 on June 29, 1956, but has not yet fully utilized interstate system apportionments for the fiscal years prior to 1957

states have obligated between 75 and 100 per cent of their 1957 funds, 6 states between 50 and 75 per cent, 2 states between 25 and 50 per cent, and 5 states have obligated less than 25 per cent of their fiscal 1957 funds or are still drawing on 1956 apportionments. A detailed state by state summary is attached.

On the interstate system only 24 states have used all of their 1957 funds and have delved into 1958 funds to the extent of 14 per cent. Three of the states—California, Rhode Island, and Maryland—have used nearly all of their 1958 apportionment.

Of the remaining 24 and the District of Columbia, 5 states have obligated between 75 and 100 per cent of their 1957 funds, 11 states are between 50 and 75 per cent, 7 states have obligated between 25 and 50 per cent. A state by state tabulation is given in Tables 1 and 2.

TABLE II

PROGRESS OF THE PRIMARY, SECONDARY, AND URBAN PROGRAM

DEPARTMENT OF COMMERCE, BUREAU OF PUBLIC ROADS

RELATIONSHIP TO FISCAL YEAR AUTHORIZATIONS, AS OF JUNE 30, 1957

Percentage of 1958 funds covered by contracts advertised and funds obligated		Percentage of 1957 funds covered by contracts advertised and funds obligated								
		100 per cent	75-100 per cent		50-75 per cent		25-50 per cent		0-25 per cent	
State	Per cent	State	State	Per cent	State	Per cent	State	Per cent	State	Per cent
Iowa	69	Iowa	Tenn.	96	N. J.	74	Md.	37	Ind.	11
Calif.	66	Calif.	Ark.	93	La.	73	W. Va.	30	Hawaii	1
Wyo.	66	Wyo.	Colo.	93	R. I.	73			Conn.	(1956)
Minn.	63	Minn.	Vt.	91	Ga.	71			D. C.	(1956)
Ala.	62	Ala.	Mass.	87	Ohio	58			P. R.	(1956)
Texas	58	Texas	Idaho	86	S. C.	52				
N. Mex.	56	N. Mex.	Ill.	85						
Oreg.	52	Oreg.	Maine	85						
Ariz.	51	Ariz.	Ky.	83						
Kans.	45	Kans.								
Nev.	40	Nev.								
Wis.	38	Wis.								
N. Y.	36	N. Y.								
N. Dak.	36	N. Dak.								
Va.	31	Va.								
Del.	28	Del.								
N. C.	27	N. C.								
S. Dak.	27	S. Dak.								
Mo.	21	Mo.								
Fla.	20	Fla.								
Alaska	20	Alaska								
Okla.	17	Okla.								
Utah	15	Utah								
Nebr.	14	Nebr.								
Mich.	12	Mich.								
U.S. Average	12	U.S. Average								
Pa.	9	Pa.								
N. H.	8	N. H.								
Miss.	6	Miss.								
Mont.	6	Mont.								
Wash.	1	Wash.								
30 States		30 States	9 States		6 States		2 States		5 States	

Summary of Progress

During the fiscal year of 1957 work on the primary, secondary, and urban roads has progressed at a rate slightly above that of 1956. The work obligated for all federal-aid roads, however, has doubled and on the interstate system has increased many times over. This has all been done in spite of the fact that: highway organizations have only been gearing themselves to handle slightly increased programs each year over a forty year period, many highway departments have required drastic reorganization to cope with the greatly expanded program, highway engineers have been in short supply, administrative and engineering techniques have needed to be modernized and streamlined.

The road building industry too has needed to step up production of road building equipment and materials. Some shortages in steel and cement have plagued progress. Recent strikes in the cement industry have nearly stopped highway construction in the east.

Coordinated Planning Needed

Above all other obstacles to progress have been controversies as to where routes should be located. Obstacles having to do with engineering and construction are being licked, but public opposition as to where the roads should go is a major problem and promises to comprise one of the main road-blocks to progress for some time in the future. Each local chamber of commerce should check to make sure it is coordinating with its highway officials in the interest of sound planning and the wisest expenditure of highway funds.

The highway officials in most states have done a good job in getting the road program under way. The program is not scheduled for completion for another 14 or 15 years. If the first year is any criteria of progress for future years, there is every reason to believe that the project will be completed on schedule.

A Rapid Method for Determining the Durability of Ledge Rock

(*Continued from Page 9*)

of dependability of the sodium sulfate test to detect this type of unsoundness. With regard to the vacuum saturated specimens, there are apparent anomalies in the durable group, which may be explained in part as due to the possible presence of large capillaries which afford a relief of hydraulic pressure or the presence of macropores. There are some erratic results in the 24-hour immersed group which may possibly be due to non-uniform distribution of pores and the use of a specimen which is larger than the critical size. It, therefore, becomes obvious that the status of this test is in a state of development so that the interpretation of test results is a matter of careful consideration of all pertinent facts. For example, a complaint was received that stone from a particular source had been performing well, but of recent years there were indications of unsatisfactory performance. Investigation brought forth the information that a new level of operations had been used for the past several years. Samples of rock from the various ledges in both levels of operation were taken from which core specimens were prepared and tested as described above. Tests on 14 ledges from the original working face showed only one thin ledge to have excessive dilation, which represented less than 6 per cent of the total. On the other hand, tests on 12 ledges from the new working level showed 4 ledges to have excessive dilation, which represented almost 50 per cent of the stone. Thus, the test becomes particularly useful when coupled with an historical background.

It is believed that this form of freezing test on ledge rock is useful, in detecting a type of behavior that is objectionable, for aggregate to be used in portland cement concrete which may be subjected to prolonged hydrostatic pressure, and freezing and thawing.

REFERENCES

1. Roger Rhoades and Richard C. Mielenz, "Petrographic and Mineralogic Characteristics of Aggregates," 1948 Symposium of Mineral Aggregates, ASTM Technical Publication No. 83
2. T. C. Powers, "Basic Considerations Pertaining to Freezing-and-Thawing Tests," 1955 ASTM Proceedings
3. W. N. Thomas, "Experiments on the Freezing of Certain Building Materials," Building Research Technical Paper No. 17, Department of Scientific and Industrial Research
4. D. W. Lewis, W. L. Dolch, and K. B. Woods, "Porosity Determinations and the Significance of Pore Characteristics of Aggregates," ASTM Proceedings 1953, Vol. 53
5. James M. Rice, "Highlights of Recent Activities in National Crushed Stone Association Laboratory," Crushed Stone Journal, December 1955

Winners Named In The National Crushed Stone Association Safety Competition of 1956

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THE Bell mine of Warner Company, Bellefonte Division, at Bellefonte, Centre County, Pennsylvania, had the best safety record of the operations enrolled in the 1956 National Crushed Stone Association Safety Competition, according to the Bureau of Mines, United States Department of the Interior. To win the bronze plaque provided by the Explosives Engineer magazine, this limestone mine operated 277,540 man-hours throughout 1956 without a lost-time injury—an outstanding achievement. The 1956 trophy award was the third that this plant had won in as many years. The Bell limestone mine has been a participant for 28 of the 31 years of this competition's existence, and during this time it has operated more than 6 million man-hours with an over-all frequency rate of 33.368 injuries sustained per million of man-hours of exposure to hazard of the crushed stone industry, and an injury severity rate of 5.846 days lost per thousand man-hours of work. It captured the coveted winner's bronze plaque in 1954, 1955, and 1956, and was awarded honorable mention in 1925, 1937, and 1951. The record of this mine clearly demonstrates what a well-designed program of accident prevention can achieve. Second place was awarded to the New York Trap Rock Corporation's Tomkins Cove limestone quarry at Tomkins Cove, New York, which operated 272,097 man-hours without a disabling injury; third, to the Bessemer limestone quarry of the Bessemer Limestone and Cement Company at Bessemer, Pennsylvania with 227,152 man-hours of injury-free operation, and fourth to the Columbia No. 1 limestone quarry of the Columbia Quarry Company at Columbia, Illinois, with 200,052 man-hours. These four operations combined worked nearly 1 million man-hours with but a single disabling work injury. To the employees, their supervisors, and the management of these organizations safety was no accident. Close teamwork and cooperation on the part of all concerned played the most important part, as it must in any successful endeavor. Congratulations, therefore, are in order to all, for setting these enviable records.

Statistics of the Competition

The over-all injury experience at the 76 crushed stone operations in the 1956 Competition was not favorable. The injury severity rate of 4.359 per thousand man-hours of work was the highest of any annual crushed stone contest since 1948. The high severity rate in 1948 and again in 1956 resulted primarily from the 4 fatalities reported in each year. This was the greatest number of fatalities sustained since 1947, when there were 10. In 1956 there were 1 permanent total injury, 7 permanent partials, and 149 temporary total injuries at the enrolled plants, more than in any year since 1950. These injuries had a total time loss or charge of 37,311 days, which is an economic loss equivalent to 1,000 men working 37 1/3 shifts.

The frequency rate for all the competing plants in 1956 was 18.809 per million man-hours. This rate was also less favorable than that of 14.445 for 1955, but more favorable than the over-all frequency rate of 27.784 for the 31 years of the competition. The injury severity rate showed a 28 per cent improvement over corresponding 31-year average rate for enrolled operations.

Of the 76 enrolled operations in the 1956 competition 64 were quarries and 12 were underground mines. The 64 quarries experienced a total of 145 injuries of which 4 were fatal, 1 permanent total, 6 permanent partial, and 134 temporary total. (See Table III). The injury severity rate of 4.882 for these injuries was 69 per cent higher than the corresponding rate of 1.535 for 1955, but was 1 per cent more favorable than for the over-all rate of 4.922 for the 31 years of the competition.

TABLE I

RELATIVE STANDING OF QUARRIES IN THE 1956 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE INJURY SEVERITY RATES OF THE QUARRIES [1]

Rank	Man-hours worked	Number of injuries [2]					Average days of disability per temp. injury	Number of days of disability [2]					Frequency rate [3]	Severity rate [3]
		F.	P.T.	P.P.	Temp.	Total		F.	P.T.	P.P.	Temp.	Total		
2	272,097	—	—	—	—	—	—	—	—	—	—	—	0.000	0.000
3	227,152	—	—	—	—	—	—	—	—	—	—	—	.000	.000
4	200,052	—	—	—	—	—	—	—	—	—	—	—	.000	.000
5	172,500	—	—	—	—	—	—	—	—	—	—	—	.000	.000
6	152,267	—	—	—	—	—	—	—	—	—	—	—	.000	.000
8	120,330	—	—	—	—	—	—	—	—	—	—	—	.000	.000
10	103,132	—	—	—	—	—	—	—	—	—	—	—	.000	.000
11	100,853	—	—	—	—	—	—	—	—	—	—	—	.000	.000
12	90,535	—	—	—	—	—	—	—	—	—	—	—	.000	.000
14	79,488	—	—	—	—	—	—	—	—	—	—	—	.000	.000
15	76,334	—	—	—	—	—	—	—	—	—	—	—	.000	.000
16	69,650	—	—	—	—	—	—	—	—	—	—	—	.000	.000
17	59,730	—	—	—	—	—	—	—	—	—	—	—	.000	.000
18	59,092	—	—	—	—	—	—	—	—	—	—	—	.000	.000
19	53,685	—	—	—	—	—	—	—	—	—	—	—	.000	.000
20	53,130	—	—	—	—	—	—	—	—	—	—	—	.000	.000
21	52,919	—	—	—	—	—	—	—	—	—	—	—	.000	.000
23	41,241	—	—	—	—	—	—	—	—	—	—	—	.000	.000
24	40,359	—	—	—	—	—	—	—	—	—	—	—	.000	.000
25	36,054	—	—	—	—	—	—	—	—	—	—	—	.000	.000
26	34,950	—	—	—	—	—	—	—	—	—	—	—	.000	.000
27	27,104	—	—	—	—	—	—	—	—	—	—	—	.000	.000
29	12,757	—	—	—	—	—	—	—	—	—	—	—	.000	.000
30	12,161	—	—	—	—	—	—	—	—	—	—	—	.000	.000
31	11,376	—	—	—	—	—	—	—	—	—	—	—	.000	.000
32	8,642	—	—	—	—	—	—	—	—	—	—	—	.000	.000
33	66,281	—	—	—	1	1	2	—	—	—	2	2	15.087	.030
34	108,852	—	—	—	1	1	4	—	—	—	4	4	9.187	.037
35	174,081	—	—	—	1	1	10	—	—	—	10	10	5.744	.057
36	29,273	—	—	—	1	1	2	—	—	—	2	2	34.161	.068
37	185,172	—	—	—	3	3	7	—	—	—	21	21	16.201	.113
38	175,286	—	—	—	2	2	10	—	—	—	20	20	11.410	.114
39	135,080	—	—	—	1	1	17	—	—	—	17	17	7.403	.126
40	149,092	—	—	—	3	3	7	—	—	—	20	20	20.122	.134
41	287,385	—	—	—	2	2	20	—	—	—	39	39	6.959	.136
42	70,719	—	—	—	1	1	10	—	—	—	10	10	14.140	.141
43	48,790	—	—	—	1	1	7	—	—	—	7	7	20.496	.143
44	125,948	—	—	—	1	1	20	—	—	—	20	20	7.940	.159
45	73,729	—	—	—	1	1	13	—	—	—	13	13	13.563	.176
46	35,830	—	—	—	2	2	4	—	—	—	8	8	55.819	.223
47	75,291	—	—	—	3	3	7	—	—	—	22	22	39.845	.292
48	55,833	—	—	—	1	1	18	—	—	—	18	18	17.911	.322
50	194,850	—	—	—	3	3	33	—	—	—	98	98	15.396	.503
52	84,256	—	—	—	3	3	18	—	—	—	54	54	35.606	.641
53	84,971	—	—	—	2	2	28	—	—	—	56	56	23.537	.659
54	30,600	—	—	—	2	2	11	—	—	—	21	21	65.359	.686
55	225,133	—	—	1	1	2	66	—	—	100	66	166	8.884	.737
56	646,740	—	—	—	19	19	32	—	—	—	612	612	29.378	.946
57	267,444	—	—	—	8	8	33	—	—	—	264	264	29.913	.987
58	455,470	—	—	—	9	9	51	—	—	—	463	463	19.760	1.017
59	17,280	—	—	—	2	2	10	—	—	—	20	20	115.741	1.157
60	131,040	—	—	—	10	10	16	—	—	—	157	157	76.313	1.198
62	40,280	—	—	—	2	2	27	—	—	—	53	53	49.652	1.316
64	25,489	—	—	—	2	2	22	—	—	—	43	43	78.465	1.687
65	144,960	—	—	1	—	1	—	—	—	264	—	264	6.898	1.821
67	206,190	—	—	1	10	11	31	—	—	120	308	428	53.349	2.076
68	97,554	—	—	—	5	5	51	—	—	—	255	255	51.254	2.614
69	41,362	—	—		5	5	31	—	—	—	155	155	120.884	3.747
70	51,548	—	—	—	2	2	108	—	—	—	215	215	38.799	4.171
71	89,440	—	—	1	—	1	—	—	—	400	—	400	11.181	4.472
72	52,384	—	—	—	5	5	77	—	—	—	385	385	95.449	7.350
74	404,092	1	—	—	7	8	13	6,000	—	—	89	6,089	19.797	15.068
75	77,585	1	—	1	3	5	17	6,000	—	1,200	50	7,250	64.445	93.446
76	160,183	2	1	1	9	13	33	12,000	6,000	600	300	18,900	81.157	117.990
Totals and rates:														
1956	7,493,083	4	1	6	134	145	29	24,000	6,000	2,684	3,897	36,581	19.351	4.882
1955	6,507,189	1	—	3	101	105	32	6,000	—	750	3,241	9,991	16.136	1.535

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., Fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE II

RELATIVE STANDING OF UNDERGROUND MINES IN THE 1956 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE INJURY SEVERITY RATES OF THE MINES [1]

Rank	Man-hours worked	Number of injuries [2] F.	P.T.	P.P.	Temp.	Total	Average days of disability per temp. injury	Number of days of disability [2] F.	P.T.	P.P.	Temp.	Total	Frequency rate [3]	Severity rate [3]
1	277,540	—	—	—	—	—	—	—	—	—	—	—	0.000	0.000
7	121,700	—	—	—	—	—	—	—	—	—	—	—	.000	.000
9	111,409	—	—	—	—	—	—	—	—	—	—	—	.000	.000
13	87,672	—	—	—	—	—	—	—	—	—	—	—	.000	.000
22	45,172	—	—	—	—	—	—	—	—	—	—	—	.000	.000
28	24,792	—	—	—	—	—	—	—	—	—	—	—	.000	.000
49	63,240	—	—	—	4	4	7	—	—	—	26	26	63.251	.411
51	56,243	—	—	—	1	1	30	—	—	—	30	30	17.780	.533
61	15,024	—	—	—	2	2	9	—	—	—	18	18	133.120	1.198
63	207,423	—	—	1	3	4	13	—	—	300	40	340	19.284	1.639
66	20,418	—	—	—	2	2	21	—	—	—	42	42	97.953	2.057
73	36,240	—	—	—	3	3	91	—	—	—	274	274	82.781	7.561
Totals and rates:														
1956	1,066,873	—	—	1	15	16	29	—	—	300	430	730	14.997	0.684
1955	1,315,811	—	1	—	7	8	42	—	6,000	—	297	6,297	6.080	4.786

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE III

YEARLY SUMMARY—QUARRIES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926–56 [1]

Year	Plants	Man-hours worked	Number of injuries [2] F.	P.T.	P.P.	Temp.	Total	Number of days of disability [2] F.	P. T.	P.P.	Temp.	Total	Frequency rate [3]	Severity rate [3]
1926	40	5,298,983	3	—	6	207	216	18,000	—	9,000	4,239	31,239	40.763	5.895
1927	48	7,876,791	9	—	2	458	469	54,000	—	2,100	7,186	63,286	59.542	8.034
1928	53	7,509,098	8	—	4	322	334	48,000	—	8,700	5,493	62,193	44.479	8.282
1929	53	7,970,325	4	—	5	286	295	24,000	—	5,760	5,533	35,293	37.012	4.428
1930	68	8,013,415	6	—	9	227	242	36,000	—	7,250	3,671	46,921	30.199	5.855
1931	58	5,085,857	4	—	13	198	215	24,000	—	18,660	3,540	46,200	42.274	9 084
1932	40	2,661,850	1	—	4	75	80	6,000	—	6,750	2,481	15,231	30.054	5.722
1933	40	2,704,871	1	—	1	67	69	6,000	—	48	2,893	8,941	25.510	3.306
1934	46	3,288,257	1	—	2	106	109	6,000	—	2,850	1,873	10,723	33.148	3.261
1935	46	4,166,306	2	1	8	77	88	12,000	6,000	9,900	3,015	30,915	21.122	7.420
1936	50	6,399,023	5	—	14	182	201	30,000	—	8,168	4,590	42,758	31.411	6.682
1937	47	6,199,001	7	—	9	136	152	42,000	—	5,875	4,461	52,336	24.520	8.443
1938	47	4,658,119	2	—	6	76	84	12,000	—	6,600	3,184	21,784	18.033	4.677
1939	44	4,219,086	2	—	2	51	55	12,000	—	4,800	1,678	18,478	13.036	4.380
1940	46	4,358,409	1	—	5	78	84	6,000	—	2,550	3,013	11,563	19.273	2.653
1941	47	5,777,587	3	—	5	98	106	18,000	—	9,300	2,266	29,566	18.347	5.117
1942	48	7,178,935	3	2	1	183	189	18,000	12,000	1,500	4,239	35,739	26.327	4.978
1943	34	4,750,314	4	—	5	134	143	24,000	—	7,146	3,862	35,008	30.103	7.370
1944	32	3,996,433	3	—	4	118	125	18,000	—	3,000	3,323	24,323	31.278	6.086
1945	46	6,087,037	—	—	1	135	136	—	—	750	3,505	4,255	22.343	.699
1946	46	7,292,175	1	—	6	197	204	6,000	—	5,141	4,130	15,271	27.975	2.094
1947	42	6,971,790	5	—	5	197	207	30,000	—	6,900	4,990	41,890	29.691	6.008
1948	47	6,953,569	4	—	11	181	196	24,000	—	8,018	4,642	36,660	28.187	5.272
1949	57	7,166,644	3	—	11	153	167	18,000	—	9,465	3,345	30,810	23.302	4.299
1950	45	6,510,173	2	—	7	153	162	12,000	—	3,854	3,825	19,679	24.884	3.023
1951	36	5,441,304	1	—	4	100	105	6,000	—	6,325	2,381	14,706	19.297	2.703
1952	36	5,279,849	3	—	3	111	117	18,000	—	1,674	2,296	21,970	22.160	4.161
1953	47	6,555,333	—	—	9	114	123	—	—	14,892	2,882	17,774	18.763	2.711
1954	55	5,880,228	1	—	9	95	105	6,000	—	6,905	2,272	15,177	17.856	2.581
1955	60	6,507,189	1	—	3	101	105	6,000	—	750	3,241	9,991	16.136	1.535
1956	64	7,493,083	4	1	6	134	145	24,000	6,000	2,684	3,897	36,581	19.351	4.882
Total	—	180,251,034	94	4	180	4,750	5,028	564,000	24,000	187,315	111,946	887,261	27.894	4.922

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE IV

YEARLY SUMMARY—UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926–56 [1]

Year	Plants	Man-hours worked	Number of injuries [2] F.	P.T.	P.P.	Temp.	Total	Number of days of disability [2] F.	P.T.	P.P.	Temp.	Total	Frequency rate [3]	Severity rate [3]
1926	3	517,926	—	—	—	34	34	—	—	—	533	533	65.646	1.029
1927	2	318,449	1	—	1	14	16	6,000	—	300	68	6,368	50.244	19.997
1928	5	542,193	1	—	1	68	70	6,000	—	300	888	7,188	129.105	13.257
1929	4	665,520	1	—	1	30	32	6,000	—	300	617	6,917	48.083	10.393
1930	6	595,367	1	—	1	15	17	6,000	—	225	468	6,693	28.554	11.242
1931	3	345,105	—	—	—	4	4	—	—	—	147	147	11.591	.426
1932	2	158,450	—	—	—	6	6	—	—	—	165	165	37.867	1.041
1933	3	229,381	—	—	—	11	11	—	—	—	349	349	47.955	1.521
1934	4	248,146	—	—	—	13	13	—	—	—	287	287	52.389	1.157
1935	2	175,994	—	—	—	3	3	—	—	—	249	249	17.046	1.415
1936	4	334,747	1	—	—	7	8	6,000	—	—	117	6,117	23.899	18.274
1937	3	364,680	—	—	—	3	3	—	—	—	91	91	8.226	.250
1938	3	334,442	—	—	—	2	2	—	—	—	133	133	5.980	.398
1939	4	393,039	—	—	1	7	8	—	—	600	457	1,057	20.354	2.689
1940	4	375,987	—	—	1	8	9	—	—	4,500	888	5,388	23.937	14.330
1941	4	591,568	—	—	1	15	16	—	—	750	169	919	27.047	1.553
1942	4	785,894	—	—	1	33	34	—	—	1,800	1,213	3,013	43.263	3.834
1943	5	1,019,771	—	—	3	45	48	—	—	4,950	1,123	6,073	47.069	5.955
1944	4	727,496	1	—	1	27	29	6,000	—	2,400	796	9,196	39.863	12.641
1945	7	1,238,845	—	—	2	22	24	—	—	3,000	755	3,755	19.373	3.031
1946	8	1,338,563	2	—	2	31	35	12,000	—	675	1,045	13,720	26.147	10.250
1947	8	1,291,162	5	—	1	29	35	30,000	—	75	1,588	31,663	27.107	24.523
1948	4	940,031	—	—	—	16	16	—	—	—	935	935	17.021	.995
1949	5	981,692	—	—	1	17	18	—	—	900	467	1,367	18.336	1.392
1950	6	1,102,273	1	—	1	25	27	6,000	—	3,000	810	9,810	24.495	8.900
1951	6	1,179,458	—	—	1	21	22	—	—	1,125	818	1,943	18.653	1.647
1952	6	1,137,449	—	—	—	19	19	—	—	—	583	583	16.704	.513
1953	6	1,260,523	—	—	—	12	12	—	—	—	487	487	9.520	.386
1954	12	915,362	1	—	—	9	10	6,000	—	—	754	6,754	10.925	7.379
1955	13	1,315,811	—	1	—	7	8	—	6,000	—	297	6,297	6.080	4.786
1956	12	1,066,873	—	—	1	15	16	—	—	300	430	730	14.997	.684
Total	—	22,492,197	15	1	21	568	605	90,000	6,000	25,200	17,727	138,927	26.898	6.177

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

In the underground mines enrolled in the 1956 competition, there were 1 permanent partial, and 15 temporary total injuries. (See Table IV). The injury severity rate declined from 4.786 in 1955 to 0.684 for 1956, and was appreciably lower than the over-all average for the 31 years, which was 6.177.

Injury-Free Operations

The following 32 operations, 26 quarries, and 6 underground mines, the latter group including the trophy winner, achieved injury-free records for which they are awarded Certificates of Honorable Mention by the National Crushed Stone Association. These 32 plants were worked 2,835,875 man-hours representing 33 per cent of the total worktime of all plants enrolled in the competition.

Bell Mine, Warner Company—Bellefonte Division, Bellefonte, Centre County, Pennsylvania; 277,540 man-hours.

Tomkins Cove Quarry, New York Trap Rock Corporation, Tomkins Cove, Rockland County, New York; 272,097 man-hours.

Bessemer Quarry, Bessemer Limestone and Cement Company, Bessemer, Lawrence County, Pennsylvania; 227,152 man-hours.

Krause No. 1 Quarry, Columbia Quarry Company, Columbia, St. Clair County, Illinois; 200,052 man-hours.

Security Quarry, North American Cement Corporation, Hagerstown, Washington County, Maryland; 172,500 man-hours.

Cheektowaga Quarry, Federal Crushed Stone Corporation, Cheektowaga, Erie County, New York; 152,267 man-hours.

TABLE V

YEARLY SUMMARY—QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-56 [1]

Year	Plants	Man-hours worked	Number of injuries [2]					Number of days of disability [2]					Frequency rate [3]	Severity rate [3]
			F.	P.T.	P.P.	Temp.	Total	F.	P.T.	P.P.	Temp.	Total		
1926	43	5,816,909	3	—	6	241	250	18,000	—	9,000	4,772	31,772	42.978	5.462
1927	50	8,195,240	10	—	3	472	485	60,000	—	2,400	7,254	69,654	59.181	8.499
1928	58	8,051,291	9	—	5	390	404	54,000	—	9,000	6,381	69,381	50.178	8.617
1929	57	8,635,845	5	—	6	316	327	30,000	—	6,060	6,150	42,210	37.865	4.888
1930	74	8,608,782	7	—	10	242	259	42,000	—	7,475	4,139	53,614	30.086	6.228
1931	61	5,430,962	4	—	13	202	219	24,000	—	18,660	3,687	46,347	40.324	8.534
1932	42	2,820,300	1	—	4	81	86	6,000	—	6,750	2,646	15,396	30.493	5.459
1933	43	2,934,252	1	—	1	78	80	6,000	—	48	3,242	9,290	27.264	3.166
1934	50	3,536,403	1	—	2	119	122	6,000	—	2,850	2,160	11,010	34.498	3.113
1935	48	4,342,300	2	1	8	80	91	12,000	6,000	9,900	3,264	31,164	20.957	7.177
1936	54	6,733,770	6	—	14	189	209	36,000	—	8,168	4,707	48,875	31.038	7.258
1937	50	6,563,681	7	—	9	139	155	42,000	—	5,875	4,552	52,427	23.615	7.987
1938	50	4,992,561	2	—	6	78	86	12,000	—	6,600	3,317	21,917	17.226	4.390
1939	48	4,612,125	2	—	3	58	63	12,000	—	5,400	2,135	19,535	13.660	4.236
1940	50	4,734,396	1	—	6	86	93	6,000	—	7,050	3,901	16,951	19.643	3.580
1941	51	6,369,155	3	—	6	113	122	18,000	—	10,050	2,435	30,485	19.155	4.786
1942	52	7,964,829	3	2	2	216	223	18,000	12,000	3,300	5,452	38,752	27.998	4.865
1943	39	5,770,085	4	—	8	179	191	24,000	—	12,096	4,985	41,081	33.102	7.120
1944	36	4,723,929	4	—	5	145	154	24,000	—	5,400	4,119	33,519	32.600	7.096
1945	53	7,325,882	—	—	3	157	160	—	—	3,750	4,260	8,010	21.840	1.093
1946	54	8,630,738	3	—	8	228	239	18,000	—	5,816	5,175	28,991	27.692	3.559
1947	50	8,262,952	10	—	6	226	242	60,000	—	6,975	6,578	73,553	29.287	8.902
1948	51	7,893,600	4	—	11	197	212	24,000	—	8,018	5,577	37,595	26.857	4.763
1949	62	8,148,336	3	—	12	170	185	18,000	—	10,365	3,812	32,177	22.704	3.949
1950	51	7,612,446	3	—	8	178	189	18,000	—	6,854	4,635	29,489	24.828	3.874
1951	42	6,620,762	1	—	5	121	127	6,000	—	7,450	3,199	16,649	19.182	2.515
1952	42	6,417,298	3	—	3	130	136	18,000	—	1,674	2,879	22,553	21.193	3.514
1953	53	7,815,856	—	—	9	126	135	—	—	14,892	3,369	18,261	17.273	2.336
1954	67	6,795,590	2	—	9	104	115	12,000	—	6,905	3,026	21,931	16.923	3.227
1955	73	7,823,000	1	1	3	108	113	6,000	6,000	750	3,538	16,288	14.445	2.082
1956	76	8,559,956	4	1	7	149	161	24,000	6,000	2,984	4,327	37,311	18.809	4.359
Total	—	202,743,231	109	5	201	5,318	5,633	654,000	30,000	212,515	129,673	1,026,188	27.784	5.062

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed

[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability

[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE VI

NUMBER OF INJURIES, BY CLASSIFICATIONS, AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1956

Classifications	Fatal	Permanent		Temporary	Total
		Total	Partial		
Falls and slides of rock or materials	1	—	—	5	6
Handling materials or objects	—	1	—	21	22
Hand tools	—	—	—	6	6
Explosives	2	—	1	1	4
Haulage	1	—	2	12	15
Falls of persons	—	—	—	28	28
Bumping against objects	—	—	—	7	7
Falling objects	—	—	1	22	23
Flying objects	—	—	—	9	9
Electricity	—	—	—	3	3
Drilling	—	—	—	—	—
Machinery	—	—	3	15	18
Stepping on objects	—	—	—	4	4
Burns	—	—	—	5	5
Other causes	—	—	—	4	4
Total	4	1	7	142	154
Not stated	—	—	—	7	7
Grand total	4	1	7	149	161

TABLE VII

DAYS OF DISABILITY, BY CLASSIFICATIONS, OF INJURIES AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1956

Classifications	Fatal	Permanent		Temporary	Total
		Total	Partial		
Falls and slides of rock or materials	6,000	—	—	235	6,235
Handling materials or objects	—	6,000	—	606	6,606
Hand tools	—	—	—	141	141
Explosives	12,000	—	600	30	12,630
Haulage	6,000	—	364	502	6,866
Falls of persons	—	—	—	1,169	1,169
Bumping against objects	—	—	—	309	309
Falling objects	—	—	400	739	1,139
Flying objects	—	—	—	64	64
Electricity	—	—	—	12	12
Drilling	—	—	—	—	—
Machinery	—	—	1,620	279	1,899
Stepping on objects	—	—	—	27	27
Burns	—	—	—	98	98
Other causes	—	—	—	36	36
Total	24,000	6,000	2,984	4,247	37,231
Not stated	—	—	—	80	80
Grand total	24,000	6,000	2,984	4,327	37,311

Pixley Mine, Stewart Sand & Material Company, Independence, Jackson County, Missouri; 121,700 man-hours.

Plant No. 1 Quarry, Callanan Road Improvement Company, South Bethlehem, Albany County, New York; 120,330 man-hours.

Kimballton Mine, Standard Lime and Cement Company, Pearisburg, Giles County, Virginia; 111,409 man-hours.

Oriskany Falls Stone Plant No. 5 Quarry, Eastern Rock Products, Incorporated, Oriskany Falls, Oneida County, New York; 103,132 man-hours.

Woodleaf Quarry, Superior Stone Company, Woodleaf, Rowan County, North Carolina; 100,853 man-hours.

Red Hill Quarry, Superior Stone Company, Charlottesville, Albemarle County, Virginia; 90,535 man-hours.

Bakerton Mine, Standard Lime and Cement Company, Bakerton, Jefferson County, West Virginia; 87,672 man-hours.

Cedar Hollow Quarry, Warner Company, Devault, Chester County, Pennsylvania; 79,488 man-hours.

Oaks Corners Quarry, General Crushed Stone Company, Geneva, Ontario County, New York; 76,334 man-hours.

Watertown Quarry, General Crushed Stone Company, Watertown, Jefferson County, New York; 69,650 man-hours.

Bakers Quarry, Superior Stone Company, Monroe, Union County, North Carolina; 59,730 man-hours.

Jordanville Quarry, General Crushed Stone Company, Jordanville, Herkimer County, New York; 59,092 man-hours.

Union Furnace Quarry, Warner Company—Bellefonte Division, Tyrone, Huntingdon County, Pennsylvania; 53,685 man-hours.

Stafford Quarry, Genesee Stone Products Corporation, Stafford, Genesee County, New York; 53,130 man-hours.

Auburn Quarry, General Crushed Stone Company, Auburn, Cayuga County, New York; 52,919 man-hours.

Cape Girardeau Mine, Federal Materials Company, Incorporated, Cape Girardeau, Cape Girardeau County, Missouri; 45,172 man-hours.

No. 8 Quarry, Columbia Quarry Company, Ullin, Pulaski County, Illinois; 41,241 man-hours.

Prospect Stone Plant No. 6 Quarry, Eastern Rock Products, Incorporated, Prospect, Oneida County, New York; 40,359 man-hours.

Webster Quarry, Kentucky Stone Company, Irvington, Breckenridge County, Kentucky; 36,054 man-hours.

Lutz Quarry, Consumers Company, Oshkosh, Winnebago County, Wisconsin; 34,950 man-hours.

Avoca Quarry, Jefferson County Stone Company, Incorporated, Avoca, Jefferson County, Kentucky; 27,104 man-hours.

Tyrone Mine, Kentucky Stone Company, Tyrone, Anderson County, Kentucky; 24,792 man-hours.

Randville Quarry, Superior Rock Products Company, Sagola, Dickinson County, Michigan; 12,757 man-hours.

Plant No. 4 Quarry, Southwest Stone Company, Knippa, Uvalde County, Texas; 12,161 man-hours.

Plant No. 2 Quarry, Catskill Mountain Stone Corporation, Hudson, Columbia County, New York; 11,376 man-hours.

Hickory Quarry, Superior Stone Company, Hickory, Catawba County, North Carolina; 8,642 man-hours.

Statistics of the Competition

The over-all safety record of the 76 operations enrolled in the 1956 competition was better than the 31-year average of the contest. Sixty-four open quarries completed the competition year with an

TABLE VIII

NUMBER AND PERCENTAGE DISTRIBUTION OF INJURIES AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION 1954–56, BY CLASSIFICATIONS

Classifications	1954		1955		1956		Total	
	Number	Per cent of total	Number	Per cent of total	Number	Per cent of total	Number	Per cent of total
Falls and slides of rock	3	2.9	5	4.6	6	3.9	14	3.8
Handling materials	21	20.2	20	18.3	22	14.3	63	17.2
Hand tools	5	4.8	5	4.6	6	3.9	16	4.3
Explosives	—	—	1	.9	4	2.6	5	1.4
Haulage	8	7.7	11	10.1	15	9.7	34	9.3
Falls of persons	12	11.5	13	11.9	28	18.2	53	14.4
Bumping against objects	10	9.6	5	4.6	7	4.5	22	6.0
Falling objects	14	13.5	15	13.8	23	14.9	52	14.2
Flying objects	6	5.8	4	3.7	9	5.8	19	5.2
Electricity	1	1.0	7	6.4	3	2.0	11	3.0
Drilling	2	1.9	3	2.7	—	—	5	1.4
Machinery	10	9.6	9	8.3	18	11.7	37	10.1
Stepping on objects	5	4.8	5	4.6	4	2.6	14	3.8
Burns	4	3.8	—	—	5	3.3	9	2.4
Other causes	3	2.9	6	5.5	4	2.6	13	3.5
Total	104	100.0	109	100.0	154	100.0	367	100.0
Causes not stated	11	—	4	—	7	—	22	—
Grand total	115	—	113	—	161	—	389	—

injury frequency rate of 19.351 per million man-hours and a severity rate of 4.882 days per thousand man-hours. Although these rates were less favorable than 1955 rates of 16.136 and 1.535, respectively, they were nevertheless consistent with the long-term improvement made since the origination of the competition.

The injury frequency rate at the 12 competing mines was 14.997 and the severity rate was 0.684, showing the mines to have had more but less severe injuries than were disclosed by the similar rates for 1955. Both reveal a downward trend when compared with the 31-year average rates of 26.898 and 6.177.

TABLE IX

NUMBER OF AND PERCENTAGE DISTRIBUTION OF DAYS OF DISABILITY FROM INJURIES AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1953–55, BY CLASSIFICATIONS

Classifications	1954		1955		1956		Total	
	Days of disability	Per cent of total	Days of disability	Per cent of total	Days of disability	Per cent of total	Days of disability	Per cent of total
Falls and slides of rock	141	0.7	35	0.2	6,235	16.8	6,411	8.6
Handling materials	488	2.2	820	5.2	6,606	17.7	7,914	10.6
Hand tools	142	.7	38	.2	141	.4	321	.4
Explosives	—	—	4	(1)	12,630	33.9	12,634	16.9
Haulage	614	2.8	579	3.6	6,866	18.4	8,059	10.8
Falls of persons	320	1.5	6,294	39.5	1,169	3.1	7,783	10.4
Bumping against objects	357	1.6	45	.3	309	.8	711	.9
Falling objects	6,697	30.8	368	2.3	1,139	3.1	8,204	11.0
Flying objects	3,613	16.6	28	.2	64	.2	3,705	4.9
Electricity	1	(1)	6,506	40.8	12	(1)	6,519	8.7
Drilling	97	.5	111	.7	—	—	208	.3
Machinery	9,129	42.0	939	5.9	1,899	5.1	11,967	16.0
Stepping on objects	29	.1	45	.3	27	.1	101	.1
Burns	81	.4	—	—	98	.3	179	.2
Other Causes	18	.1	126	.8	36	.1	180	.2
Total	21,727	100.0	15,938	100.0	37,231	100.0	74,896	100.0
Causes not stated	204	—	350	—	80	—	634	—
Grand total	21,931	—	16,288	—	37,311	—	75,530	—

[1] Less than 0.05 per cent

TABLE X

EMPLOYMENT AND INJURY DATA FOR CRUSHED STONE PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1955 AND 1956, COVERING IDENTICAL PLANTS FOR BOTH YEARS AND PLANTS ENROLLED ONLY IN 1955 OR IN 1956 [1]

	No.	Man-hours worked	Number of injuries [2]					Days of disability [2]					Frequency rate [3]	Severity rate [3]
			F.	P.T.	P.P.	Temp.	Total	F.	P.T.	P.P.	Temp.	Total		
Plants enrolled in 1955 only	8	896,762	—	1	1	12	14	—	6,000	300	369	6,669	15.612	7.437
Identical plants enrolled both years, 1955	65	6,926,238	1	—	2	96	99	6,000	—	450	3,169	9,619	14.293	1.389
Identical plants enrolled both years, 1956	65	6,959,963	3	1	6	116	126	18,000	6,000	2,720	3,536	30,256	18.104	4.347
Plants enrolled in 1956 only	11	1,599,993	1	—	1	33	35	6,000	—	264	791	7,055	21.875	4.409

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed
[2] F., fatal; P. T., permanent total disability; P. P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure

TABLE XI

AVERAGE DAYS OF DISABILITY PER TEMPORARY INJURY AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION

Year	Underground mines			Open quarries			Total		
	Number of temporary injuries	Number of days of disability	Average days of disability	Number of temporary injuries	Number of days of disability	Average days of disability	Number of temporary injuries	Number of days of disability	Average days of disability
1926	34	533	16	207	4,239	20	241	4,772	20
1927	14	68	5	458	7,186	16	472	7,254	15
1928	68	888	13	322	5,493	17	390	6,381	16
1929	30	617	21	286	5,533	19	316	6,150	19
1930	15	468	31	227	3,671	16	242	4,139	17
1931	4	147	37	198	3,540	18	202	3,687	18
1932	6	165	28	75	2,481	33	81	2,646	33
1933	11	349	32	67	2,893	43	78	3,242	42
1934	13	287	22	106	1,873	18	119	2,160	18
1935	3	249	83	77	3,015	39	80	3,264	41
1936	7	117	17	182	4,590	25	189	4,707	25
1937	3	91	30	136	4,461	33	139	4,552	33
1938	2	133	67	76	3,184	42	78	3,317	43
1939	7	457	65	51	1,678	33	58	2,135	37
1940	8	888	111	78	3,013	39	86	3,901	45
1941	15	169	11	98	2,266	23	113	2,435	22
1942	33	1,213	37	183	4,239	23	216	5,452	25
1943	45	1,123	25	134	3,862	29	179	4,985	28
1944	27	796	29	118	3,323	28	145	4,119	28
1945	22	755	34	135	3,505	26	157	4,260	27
1946	31	1,045	34	197	4,130	21	228	5,175	23
1947	29	1,588	55	197	4,990	25	226	6,578	29
1948	16	935	58	181	4,642	26	197	5,577	28
1949	17	467	27	153	3,345	22	170	3,812	22
1950	25	810	32	153	3,825	25	178	4,635	26
1951	21	818	39	100	2,381	24	121	3,199	26
1952	19	583	31	111	2,296	21	130	2,879	22
1953	12	487	41	114	2,882	25	126	3,369	27
1954	9	754	84	95	2,272	24	104	3,026	29
1955	7	297	42	101	3,241	32	108	3,538	33
1956	15	430	29	134	3,897	29	149	4,327	29
Total	568	17,727	31	4,750	111,946	24	5,318	129,673	24

Nineteen states were represented in the 1956 competition. They were: New York with 19 operations; Pennsylvania and Kentucky, 9 each; Illinois and North Carolina, 6 each; Missouri, 5; Connecticut, Virginia, and Wisconsin, 3 each; Maryland, Michigan, and Texas, 2 each; and single operations in Georgia, Massachusetts, New Jersey, Ohio, Oklahoma, Tennessee, and West Virginia.

Injury Experience

Principal causes of injury among the 1956 competing participants were: Falls of persons, resulting in 28 disabilities or 18 per cent of all injuries with reported causes; falling objects, resulting in 15 per cent; handling materials, 14 per cent; machinery, 12 per cent; and haulage, 10 per cent. The most severe injuries during the 1956 competition resulted from explosives, haulage, handling materials, falls and slides of rock, and machinery. These five causes were responsible for 92 per cent of the total number of days of disability.

The Competition

The winning operation in the annual National Crushed Stone Association Safety Competition is awarded a bronze plaque portraying in bas-relief the quarry scene on the pedestal of the "Sentinels of Safety" trophy awarded in the National Safety Competition. The plaque is furnished by the Explosives Engineer magazine. Each plant in the contest, except the winner, that operated throughout the year without a lost-time injury is given an honorable mention award of a parchment certificate which is a reproduction of the bronze plaque. In addition, each employee of an accident-free operation is presented a Certificate of Honor.

This safety competition is designed specifically to promote safety within the crushed stone industry. It is conducted annually by the Federal Bureau of Mines and sponsored by the National Crushed Stone Association. It is conducted under the same rules as the National Safety Competition and the same records are used in both contests. There are two additional qualifications for the crushed stone competition, which are: the operation must have commercial production of crushed stone, and the company must be a member of the Association.

A plant may be enrolled on application to the Branch of Accident Analysis, Division of Safety, United States Bureau of Mines, Washington 25, D. C.

1957 Edition of ACI Standards

THE 1957 edition of the ACI Book of Standards is now off the press, representing the most recent compilation of current ACI standards, recommended practices, and specifications.

Eleven ACI standards are compiled under one cover, incorporating such subjects as the evaluation of compression test results; building code requirements for reinforced concrete; design and construction of concrete chimneys; winter concreting; selection of proper proportions for concrete; and the measuring, mixing and placing of concrete.

Building Code Requirements for Reinforced Concrete (ACI 318-56) covers the proper design and construction of buildings of reinforced concrete.

Another specification, ACI 505-54, is devoted completely to the design and construction of reinforced concrete chimneys. ACI 711-53 presents the standard minimum requirements for precast concrete floor units.

Standard specifications for the construction of portland cement concrete pavement and base under normal conditions, including the preparation of the subgrade, are discussed in ACI 617-51. Subjects covered include: materials, proportions of materials based on design for minimum strength or based on uniform cement factor; measurement and handling of materials; mixing; high-early-strength concrete; subgrade preparation; forms; installation of joints and reinforcement; placing and finishing of concrete; and the curing of concrete.

The use of statistical methods, ACI 214-57, provides valuable tools for assessing results of strength tests, and such information is also of value in refining design criteria and specifications.

ACI 805-51 describes briefly the advantages and disadvantages of pneumatically-placed mortar and establishes recommended practices for the placing and mixing of shotcrete.

Air-entrained concrete and one percent of calcium chloride by weight of cement are recommended for cold weather concreting in ACI 604-56. The use of accelerators and antifreezes, keeping of temperature records, heating of materials, subgrade preparation, protective coverings, heated enclosure, curing, and form removal are discussed for several types of concrete structures and preferred methods are indicated.

This 300-page book is of 6 x 9-inch format, available at $4.00 per copy from American Concrete Institute, P. O. Box 4754, Redford Station, Detroit 19, Mich.

Manufacturers Division
National Crushed Stone Association

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These associate members are morally and financially aiding the Association in its efforts to protect and advance the interests of the crushed stone industry. Please give them favorable consideration whenever possible.

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Allis-Chalmers Mfg. Co.
Milwaukee 1, Wis.
Crushing, Screening, Washing, Grinding, Cement Machinery; Motors; Texrope Drives; Centrifugal Pumps; Air Compressors; Hauling Equipment; Engines; Tractors

American Cyanamid Co.
Explosives Department
30 Rockefeller Plaza, New York 20, N. Y.
Explosives and Blasting Supplies

American Manganese Steel Division
American Brake Shoe Co.
155 North Wacker Drive, Chicago 6, Ill.
Manganese and Alloy Steel Castings, Power Shovel Dippers, Material Handling Pumps, Reclamation and Hard-Facing Welding Materials, Automatic and Semi-Automatic Welding Machines

American Pulverizer Co.
1249 Macklind Ave., St. Louis 10, Mo.
Manufacturers of Ring Crushers and Hammermills for Primary and Secondary Crushing and Laboratory Sizes

American Steel & Wire Division
United States Steel Corp.
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Barber-Greene Co.
400 North Highland Ave., Aurora, Ill.
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Birdsboro-Buchanan Crusher Dept.
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1941 Furnace St., Birdsboro, Pa.
Primary and Secondary Crushers and Rolls

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Conveyor, Elevator, and Transmission Belts, V-Belts; Sand Blast, Water, Steam, Air, Suction Hoses

Brunner & Lay Rock Bit of Asheville, Inc.
P. O. Box 5235, Asheville, N. C.
Tungsten Carbide Detachable Bits, "Rock Bit" Drill Steel Inlaid with Tungsten Carbide, Carbon Hollow Drill Steel, Alloy Hollow Drill Steel

Bucyrus-Erie Co.
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Excavating, Drilling, and Material Handling Equipment

Canadian Industries Ltd.
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Commercial Explosives and Blasting Accessories

Cape Ann Anchor & Forge Co.
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"Cape Ann" Forged Steel Drop Balls

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Track-Type Tractors, Bulldozers, Earthmoving Scrapers, Motor Graders, Heavy-Duty Off-Road Hauling Units, Diesel Engines, Diesel Electric Generating Sets, Front End Shovels, Wheel-Type Tractors

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P. O. Box 2022, Milwaukee 1, Wis.
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(continued)

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Tractor Shovels; Tractor Dozers; Tractor Scrapers; Truck and Crawler Excavator-Cranes

Continental Gin Co.
Industrial Division
4500 Fifth Ave., S., Birmingham 2, Ala.
Conveyors—Belt, Screw, Flight, and Underground Mine; Elevators—Bucket and Screw; Feeders—Apron, Belt, Reciprocating, Table, and Screw; Drives—V-Belts, Chains and Sprockets, Gears and Speed Reducers

Contractors and Engineers Magazine
470 Fourth Ave., New York 16, N. Y.
Magazine of Modern Construction

Cross Engineering Co.
P. O. Box 507, Carbondale, Pa.
Cross Perforated Steel Segments, Sections, Decks, for Vibrating, Shaking, Revolving, and Other Types of Screening Equipment

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Dart Truck Co.
2623 Oak St., Kansas City 8, Mo.
Off-Highway Trucks—End, Side, Bottom Dumps

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Deister Vibrating Screens, Classifiers, Washing Equipment

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P.O. Box 628, Salem, Va.
"Air-Trac" Drill Carrier

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Dust Collecting Equipment; Dust Control Systems; Feeders

Eagle Crusher Co., Inc.
900 Harding Way East, Galion, Ohio
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Eagle Iron Works
129 Holcomb Ave., Des Moines 13, Iowa
Fine Material Screw Washers — Classifiers — Dehydrators; Coarse Material Screw and Log Washers — Dewaterers; Water Scalping and Fine Material Settling Tanks; Drop Balls — Ni-Hard and Semi-Steel; "Swintek" Screen Chain Cutter Dredging Ladders; Revolving Cutter Head Dredging Ladders

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"Indian Brand" Manganese Steel Castings for all Types of Jaw, Gyratory, and Pulverizing Crushers; Dippers, Teeth, Treads, and Other Parts for Power Excavating Equipment; and Other Miscellaneous Manganese Steel Castings. Manufacturers and Fabricators of Railroad and Mine Frogs, Switches, and Crossings

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Plant Layout, Design, Supervision; Open Pit Quarry Surveys; Appraisals — Plant and Property

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Hughes Tool Co.
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Illinois Powder Mfg. Co.
506 Olive St., St. Louis 1, Mo.
Gold Medal Explosives

Ingersoll-Rand Co.
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Rock Drills, Paving Breakers, Paving Breaker Accessories, Quarrymaster Drills, Drillmasters, Carset Bits, Jackbits, Bit Reconditioning Equipment, Portable and Stationary Air Compressors, Air Hoists, Slusher Hoists, Pneumatic Tools, Centrifugal Pumps, Diesel and Gas Engines

Insley Manufacturing Corp.
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1/2 to 1 Cu. Yd. Cranes and Shovels—5 to 35 Tons Capacity, Rubber or Crawler Mounting; Concrete Carts and Buckets

Manufacturers Division — National Crushed Stone Association

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Johnson-March Corp.
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Drills: Blast-Hole, Wagon, Rock, and Core; Air Compressors: Portable, Stationary, and Semi-Portable; Aftercoolers; Portable Blowers; Carpullers; Hoists; Multi-Purpose and Portable Rock Loaders; Air Motors; Trench Diggers; Belt Conveyors; "Spaders"; "String-a-Lite" (Safety-Lighting-Cable); Backfill Tampers; Drill Bits: Rock and Core

Kennedy-Van Saun Mfg. & Eng. Corp.
2 Park Ave., New York 16, N. Y.
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King Powder Co., Inc.
Cincinnati, Ohio
Detonite, Dynamites, and Blasting Supplies

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3026 West Concordia Ave., Milwaukee 16, Wis.
Excavating, Hauling, and Concrete Equipment

Linde Air Products Co., Division of Union Carbide and Carbon Corp.
30 East 42nd St., New York 17, N. Y.
Oxygen, Acetylene, Welding and Jet Piercing Equipment and Supplies

Link-Belt Co.
300 West Pershing Road, Chicago 9, Ill.
Complete Stone Preparation Plants; Conveyors, Elevators, Screens, Washing Equipment, and Power Transmission Equipment

Link-Belt Speeder Corp.
1201 Sixth St., S. W., Cedar Rapids, Iowa
Complete Line of Speed-o-Matic Power Hydraulically Controlled Cranes, Shovels, Hoes, Draglines, and Clamshells, 1/2 to 3-Yd. Capacities. Available on Crawler Base or Rubber Tire Mounting. Diesel Pile Hammers

Lippmann Engineering Works, Inc.
4603 W. Mitchell St., Milwaukee 14, Wis.
Primary and Secondary Rock Crushers and Auxiliary Equipment such as Feeders, Screens, Conveyors, Etc., Portable and Stationary Crushing and Washing Plants

Ludlow-Saylor Wire Cloth Co.
634 South Newstead Ave., St. Louis 10, Mo.
Woven Wire Screens and Wire Cloth of Super-Loy, Steel, and All Other Commercial Alloys and Metals

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Richmond St. & Castor Ave., Phila. 34, Pa.
ROL-MAN 11.00 to 14.00 Per Cent Rolled Manganese Steel Woven and Perforated Screens, and Fabricated Parts for Aggregate Handling Equipment

Marion Power Shovel Co.
Division of Universal Marion Corp.
617 West Center St., Marion, Ohio
Power Shovels, Draglines, Cranes, Truck Cranes—From 1/2 to 75 Yd.

McLanahan & Stone Corp.
252 Wall St., Hollidaysburg, Pa.
Complete Pit, Mine, and Quarry Equipment—Crushers, Washers, Screens, Feeders, Etc., Semi-Portable Plants

Mercer Rubber Co.
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Murphy Diesel Co.
5317 West Burnham St., Milwaukee 14, Wis.
Engines—Industrial Engine, and Power Units for Operation on Diesel and Dual Fuel Engines. Generator Sets, AC and DC from 64 Kw. to 165 Kw. Mech-Elec Unit—Combination Mechanical and Electric Power Furnished Simultaneously

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Nordberg Mfg. Co.
Milwaukee 1, Wis.
Symons Cone Crushers, and Symons Gyratory and Impact Crushers; Gyradisc Crushers; Grinding Mills; Stone Plant and Cement Mill Machinery; Vibrating Screens and Grizzlies; Diesel Engines and Diesel Generator Units; Mine Hoists; Railway Track Maintenance Machinery

Northern Blower Co.
6409 Barberton Ave., Cleveland 2, Ohio
Dust Collecting Systems, Fans—Exhaust and Blower

Northwest Engineering Co.
135 South LaSalle St., Chicago 3, Ill.
Shovels, Cranes, Draglines, Pullshovels—Crawler and Truck Mounted

Olin Mathieson Chemical Corp.
Explosives Division
East Alton, Ill.
Explosives, Blasting Caps, Blasting Accessories

Pennsylvania Crusher Division
Bath Iron Works Corp.
323 South Matlack St., West Chester, Pa.
Single Roll Crushers, Impactors, Reversible Hammermills, Ring Type Granulators, Kue-Ken Jaw Crushers, Kue-Ken Gyratories, Non-Clog and Standard One-Way Hammermills

Pettibone Mulliken Corp.
4710 West Division St., Chicago 51, Ill.
Material Handling Buckets, Clamshells, Draglines, Pullshovels, Dippers, Shovel Dippers, Pumps, Front End Loaders, Bucket Conveyor Loaders, Fork and Bucket Loaders, Speed Swing Loaders, Speed Swing Yard Cranes, Motor Graders, Manganese Steel Castings

Pioneer Engineering
Division of Poor & Co.
3200 Como Ave., Minneapolis 14, Minn.
Jaw Crushers, Roll Crushers (Twin and Tripple), Impact Crushers, Vibrating and Revolving Screens, Feeders (Reciprocating, Apron, and Pioneer Oro Manganese Steel), Belt Conveyors, Idlers, Accessories and Trucks, Portable and Stationary Crushing and Screening Plants, Washing Plants, Mining Equipment, Cement and Lime Equipment, Asphalt Plants, Mixers, Dryers and Pavers

Pit and Quarry Publications, Inc.
431 South Dearborn St., Chicago 5, Ill.
Pit and Quarry, Pit and Quarry Handbook, Pit and Quarry Directory, Concrete Manufacturer, Concrete Industries Yearbook, Equipment Distributor's Digest

Productive Equipment Corp.
2926 West Lake St., Chicago 12, Ill.
Vibrating Screens

Quaker Rubber
Division of H. K. Porter Co., Inc.
Tacony and Milnor Sts., Philadelphia 24, Pa.
Conveyor Belts, Hose, and Packings

Radio Corporation of America
Inspection and Control Section
Front and Cooper Sts., Bldg. 15-1
Camden 2, N. J.
Tramp Metal Detectors

Rock Products and Concrete Products
79 West Monroe St., Chicago 3, Ill.

Rogers Iron Works Co.
11th & Pearl Sts., Joplin, Mo.
Jaw Crushers, Roll Crushers, Hammermills, Vibrating Screens, Revolving Screens and Scrubbers, Apron Feeders, Reciprocating Feeders, Roll Grizzlys, Conveyors, Elevators, Portable and Stationary Crushing and Screening Plants, Mine Hoists, Drill Jumbos and Underground Loaders

Schramm, Inc.
West Chester, Pa.
Air Compressors, Rotary Drills, Pneumatic Drills, Etc.

Screen Equipment Co., Inc.
1754 Walden Ave., Buffalo 25, N. Y.
Seco Vibrating Screens; Scales—Industrial, Aggregates, Truck

Simplicity Engineering Co.
Durand, Mich.
Simplicity Gyrating Screens, Horizontal Screens, Simpli-Flo Screens, Tray Type Screens, Heavy Duty Scalpers, D'Watering Wheels, D'Centegrators, Vibrating Feeders, Vibrating Pan Conveyors, Car Shake-Outs, Woven Wire Screen Cloth, Grizzly Feeders

SKF Industries, Inc.
Front St. and Erie Ave.,
P. O. Box 6731, Philadelphia 32, Pa.
Anti-Friction Bearings—Self-Aligning Ball, Single Row Deep Groove Ball, Angular Contact Ball, Double Row Deep Groove Ball, Spherical Roller, Cylindrical Roller, Ball Thrust, Spherical Roller Thrust; Tapered Roller Bearings; Pillow Block and Flanged Housings—Ball and Roller

Smith Engineering Works
532 East Capitol Drive, Milwaukee 12, Wis.
Gyratory, Gyrasphere, Jaw and Roll Crushers, Vibrating and Rotary Screens, Gravel Washing and Sand Settling Equipment, Elevators and Conveyors, Feeders, Bin Gates, and Portable Crushing and Screening Plants

Manufacturers Division – National Crushed Stone Association
(concluded)

Soiltest, Inc.
4711 W. North Ave., Chicago 39, Ill.
Laboratory and Field Testing Apparatus

Stedman Foundry & Machine Co., Inc.
Aurora, Ind.
Stedman Impact-Type Selective Reduction Crushers, 2-Stage Swing Hammer Limestone Pulverizers, Multi-Cage Limestone Pulverizers, Vibrating Screens

Stephens-Adamson Mfg. Co.
Aurora, Ill.
Belt Conveyors, Pan Conveyors, Bucket Elevators, "Amsco" Manganese Steel Pan Feeders, Vibrating Screens, Belt Conveyor Carriers, Bin Gates, Car Pullers, "Sealmaster" Ball Bearing Units, "Saco" Speed Reducers, and Complete Engineered Stone Handling Plants

Taylor-Wharton Co.
Division Harsco Corp.
High Bridge, N. J.
Manganese and Other Special Alloy Steel and Iron Castings; Dipper Teeth, Fronts and Lips; Crawler Treads; Jaw and Cheek Plates; Mantles and Concaves; Pulverizer Hammers and Liners; Asphalt Mixer Liners and Tips; Manganese Nickel Steel Welding Rod and Plate; Elevator, Conveyor and Dredge Buckets

Thew Shovel Co.
East 28th St. and Fulton Rd., Lorain, Ohio
"Lorain" Power Shovels, Cranes, Draglines, Clamshells, Hoes, Scoop Shovels on Crawlers and Rubber-Tire Mountings. Diesel, Electric, and Gasoline, 3/8 to 2-1/2 Yd. Capacities

Thor Power Tool Co.
Prudential Plaza, Chicago 1, Ill.
Wagon Drills, Rock Drills, Sump Pumps, Clay Diggers, Paving Breakers, Quarry Bars, Sinker Legs, Drifters, Rock Drilling Jumbos, Raiser Legs, Push Feed Rock Drills, Air and Electric Tools, Accessories

Torrington Co.
Bantam Bearings Division
3702 West Sample St., South Bend 21, Ind.
Anti-Friction Bearings; Self-Aligning Spherical, Tapered, Cylindrical, and Needle Roller; Roller Thrust; Ball Bearings

Tractomotive Corp.
County Line Road, Deerfield, Ill.
Rubber Tired Front-End Loaders (Tracto-Loaders)

Travel Drill Co.
P. O. Box 1124, Raleigh, N. C.
"Travel Drill"—Mobile Drill for Secondary Drilling in Quarries and Open Pit Work

Traylor Engineering & Mfg. Co.
Allentown, Pa.
Stone Crushing, Gravel, Lime, and Cement Machinery

Trojan Powder Co.
17 North Seventh St., Allentown, Pa.
Explosives and Blasting Supplies

Tyler, W. S., Co.
3615 Superior Ave., N.E., Cleveland 14, Ohio
Woven Wire Screens; Ty-Rock, Tyler-Niagara and Ty-Rocket (Mechanically Vibrated) Screens; Hum-mer Electric Screens; Ro-Tap Testing Sieve Shakers, Tyler Standard Screen Scale Sieves, U. S. Sieve Series

Universal Engineering Corp.
625 C Ave., N.W., Cedar Rapids, Iowa
Jaw Crushers, Roll Crushers, TwinDual Roll Crushers, Hammermills, Impact Breakers, Pulverizers, Bins, Conveyors, Feeders, Screens, Scrubbers. Bulldog Non-Clog Moving Breaker Plate and Stationary Breaker Plate Hammermills, Center Feed Hammermills. A Complete Line of Stationary and Portable Crushing, Screening, Washing, and Loading Equipment for Rock, Gravel, Sand, and Ore. Aglime Plants. Asphalt Plants

Vibration Measurement Engineers
725 Oakton St., Evanston, Ill.
Seismographic and Airblast Measurements, Seismological Engineering, Blasting Complaint Investigations, Expert Testimony in Blasting Litigation; Nation-wide Coverage; A Complete Seismograph Rental and Record Analysis Service with "Seismolog"

Werco Steel Co.
2151 East 83rd St., Chicago 17, Ill.
Castings—Manganese, Alloy Steel; Screen Plates—Perforated Steel Screen Sections and Decks; Buckets; Chains; Belt Conveyors, Idlers; Dipper—Shovel; Drop Balls; Wire Cloth; Wire Rope and Related Products; Crushers, Pulverizers

White Motor Co.
842 East 79th St., Cleveland 1, Ohio
On- and Off-Highway Trucks and Tractors—Gasoline- and Diesel-Powered; Industrial Engines—Gasoline and Diesel; Power Units, Axles, Special Machine Assemblies; Crane and Shovel Carriers; Power Generating and Distributing Systems; Batteries; All Classes of Maintenance and Repair Services

White Motor Co.
Autocar Division
Exton, Pa.
Motor Trucks

Wickwire Spencer Steel Division
Colorado Fuel and Iron Corp.
575 Madison Ave., New York 22, N. Y.
Wire Rope, Vibrating and Space Screens, Screen Plate—Perforated Steel

Williams Patent Crusher & Pulverizer Co.
2701-2723 North Broadway, St. Louis 6, Mo.
Hammer Mills, Crushers, Pulverizers, Roller Mills, Reversible Impactors, and Vibrating Screens, and Air Separators

NATIONAL CRUSHED STONE ASSOCIATION
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